Formation of Polyimide Electronic Passivation Film by Electrophoresis Deposition

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Introduction

Nowadays, semiconductor or electronic technology is growing rapidly. In the mean time, the demand for electronic-use chemicals or materials is also greatly increased. Polyimide is widely used as a passivation layer in the semiconductor device or dielectric material in the printed circuit board, etc [1]. In this study, a polyimide passivation layer is obtained by electrophoresis deposition [2]. A series of experiments was carried out in order to get an optimum parameter so that a passivation film with good electrical and adhesion properties is achieved.

Experimental

Two types of polyamic acid (PAA), the precursor of polyimide, were synthesized by condensation polymerization, one was polymerized from the monomer diaminodiphenyl ether (ODA) and pyromellitic dianhydride (PMDA), PAA(I), the other was polymerized from the monomer 2,2-bis(4-[aminophenoxy]phenyl) (BAPP) and pyromellitic dianhydride (PMDA), PAA (II).
Triethylamine (TEA) was added into the synthesized PAA with different mole ratio of COOH/TEA, where N-methyl-2-pyrrolidone (NMP) was also added as a solvent to form a polymer solution with 2.8 wt% of solid content. This polymer solution was heated to react at 40°C for 20 minutes. After then, acetone was slowly added into this reacted polymer solution with different volume ratio of acetone/NMP, ranging from 3/1 to 7/1, formed electrobath with different composition.
During electrodeposition, working electrode was the anode, a copper substrate with a total area of 4.25 cm^2. The applied voltage was 70V and the time of electrodeposition was 120 sec.
These electrodeposited samples were then underwent a curing process with different heating rate, ranging from 1.5 to 7°C/min. After cured, electrical and adhesion test were carried out on each samples to get an optimum parameter.

Results and discussion

Changing the COOH/TEA mole ratio of the electrobath, the optimum value would shift to different Acetone/NMP volume ratio. Under the PAA (I) system, when the COOH/TEA mole ratio at 1.0/0.5 and 1.0/1.0, respectively, each of them had an optimum value when the acetone/NMP volume ratio at 5.0/1.0 and 3.0/1.0, respectively. PAA (II) system, each of them had an optimum value when the acetone/NMP volume ratio at 7.0/1.0 and 6.0/1.0, respectively as shown in Figures1.

Conclusions

Comparing the electrical, adhesion properties as well as the surface uniformity of all these samples, an optimum parameter with composition of electrobath with COOH/TEA mole ratio at 1.0/0.5 and Acetone/NMP volume ratio at 7.0/1.0, where the curing process with a heating rate at 7.0°C/min.

References

1. Wang, T.H.; Ho, S.M.; Chen, K. M.; Hung, A., *J. Appl; Polym. Sci.* 1993, 47, p. 1057-64.
2. Lim, M. Y.; Chou, T. C., *Abstracts of the 196th Meeting of the Electrochemical Society, Oct 17-22, 1999*, p.918.

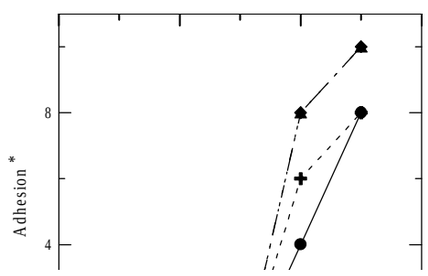

Figure 1 Effect of acetone/NMP volume ratio on adhesion of polyimide film on copper foil substrate in PAA (II) system, when COOH/TEA mole ratio is 1.0/0.5.
Each line shows data of different heat treatment,
● : room temperature 1.5℃/min 350 ℃ (5 min),
+ : room temperature 3.0℃/min 350 ℃ (5 min),
◆ : room temperature 5.0℃/min 350 ℃ (5 min),
▲ : room temperature 7.0℃/min 350 ℃ (5 min).
Applied voltage = 70 V, time of electrophoresis = 120 sec, total area of substrate = 4.25 cm^2.*